

New Hampshire Northcoast Railroad Improvements Benefit-Cost Analysis

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1. INTRODUCTION

1.1 Background and Purpose

The condition of ties, surface and ballast together with drainage problems have limited the ability of the New Hampshire Northcoast Railroad (NHN) to operate its freight service to capacity and expand freight service on its line. The New Hampshire Northcoast Railroad Improvements project will upgrade, repair and make improvements to the track infrastructure including tie replacement, new ballast, resurfacing, and two grade crossings.

The rail line currently provides freight service to a large sand and gravel operation in Ossipee, NH, transporting these materials to a transload in Rochester, NH and Boston; to propane distribution facilities along the rail line; and mixed freight to other shippers. The rail corridor connects with Pan Am Railways in Rollinsford, NH and to a rail-banked line owned by the State of New Hampshire in Ossipee. The railroad line closely parallels NH Route 16, the major north-south highway in eastern New Hampshire and a major route for both trucking and tourist travel to New Hampshire's lakes and mountains. Present volume on the line is approximately 4,000 railcars per year.

The Benefit-Cost Analysis described in the following sections estimates the benefits and costs associated with completing the railroad upgrade. The project is evaluated as compared to the current system, which is considered the baseline, and a future scenario without major capital improvements.

1.2 Summary of Benefit-Cost Results

Using the TIGER guidance recommended discount rate of 7 percent, the Northcoast Rail improvements will result in:

- Total benefits of \$11.4 million in present value terms;
- Total costs of \$5.9 million in present value terms;
- Total net present value of \$7.9 million, with a benefit-cost ratio of 3.3 at a 7 percent discount rate.

A benefit-cost ratio (BCR) of 3.3 at a 7 percent discount rate indicates that the benefits of the project outweigh the costs, suggesting that the project is economically justifiable. For comparison purposes, the BCR was also calculated at a 3 percent discount rate, resulting in a BCR of 5.4 for railroad upgrade.

1.3 Organization of the Report

This report provides the framework of the benefit-cost analysis in Section 2. Information related to the rail traffic estimation utilized in the analysis is provided in Section 3. Benefits and costs

are detailed in Section 4, and Section 5 presents the results with a conclusion evaluating the findings of the study. Tables are provided throughout the report to better illustrate the analysis.

2. FRAMEWORK OF THE ANALYSIS

A comparison of the benefits and costs of a project can give an indication of whether or not a project is worthwhile. To be deemed economically feasible, projects must pass one or more value benchmarks: the total benefits must exceed the total costs on a present value basis; and/or the rate of return on the funds invested should exceed the cost of raising capital, often defined as the long-term treasury rate or the social discount rate. A fundamental tenet of the benefit-cost analysis approach is that only those incremental benefits directly attributable to the construction and operation of the project are included in the estimation of benefits and costs.

For this analysis, the cost to build and operate represents the foregone value of an alternative investment. The benefits of the project refer to the improvement in the social well-being delivered by the project.

2.1 Benefit-Cost Analysis

In the NHN rail improvements benefit-cost analysis, benefits are estimated for current and future users on an incremental basis; that is, the change in welfare that consumers and, more generally, society derive from access to the improved rail, as compared to the current situation. As with most transportation projects, the benefits derived from the implementation of infrastructure projects are actually a reduction in the costs associated with transportation activities. For example, the reduction of costs due to the rail improvements affects users differently, depending on their preferences and the way the project changes their individual transportation costs.

The benefits of a project are the cost reductions that may result from the project's implementation. These cost reductions may come in the form of reductions in the operating expenses, reduction of pollution or, more generally, a combination of these effects.

2.1.1 Principles

The Benefit-Cost Analysis was conducted by HDR Decision Economics using methods and parameters consistent with the US Department of Transportation and the Transportation Investment Generating Economic Recovery (TIGER) and TIGER II Discretionary Grants guidance. The following principles guide the estimation of benefits and costs in the analysis:

- Only incremental benefits and costs are measured.
 - Incremental benefits of the project include transportation cost savings for users of the railroad, as well as highway users who benefit from the improved alternate mode of freight transport.
 - Incremental costs of implementation of the project include initial and recurring costs. Initial costs refer to capital costs incurred for design and construction of the rail upgrade project. Recurring costs include incremental

operating costs and maintenance expenses. Only additions in costs to the current operations and planned investments are considered in the analysis.

- Benefits and costs are valued at their opportunity costs.
 - The benefits stemming from the Northcoast Rail improvements are those above and beyond the benefits that could be obtained from the best transportation alternative.

2.1.2 Measurement Data and Assumptions

As part of the TIGER II grant application process, which was the impetus behind this analysis, benefits and costs associated with specific long term outcomes criteria were estimated. Table 1 presents the benefits measured in this project application as they relate to the five long term outcomes identified in the TIGER II grant guidance: State of Good Repair; Economic Competitiveness; Sustainability; Livability; and, Safety.

Table 1: Benefits and Description of Evaluation Criteria Identified in Long Term Outcomes

Criteria	Benefit(s)	Description
State of Good Repair	Pavement Maintenance Savings	Pavement maintenance costs/savings due to diversion of traffic to rail
Economic Competitiveness	Shipper Cost Savings	Costs/savings associated with movement of cargo from one mode of transport to another (e.g., truck to freight rail transport)
Sustainability	Emissions Reductions	Reductions in pollutants and green house gases due to auto and truck use reductions because freight is diverted off highways and on to rail
Livability	Congestion Reduction	Reduction in congestion associated with diversion of some trucks from highway to freight rail
Safety	Accident Reduction	Reductions in property losses and injuries and deaths due to diversion of truck traffic off of roads

2.1.3 Valuation

The valuation of benefits makes use of a number of assumptions that are required to produce monetized values for non-pecuniary benefits. For instance, various vehicle emissions are monetized using estimates of “social costs” based on the best available scientific studies. These social cost estimates of greenhouse gases include human health impacts and quality of life. United States Department of Transportation (USDOT) valuation guidance on the preparation of TIGER II applications was used in the analysis. Where USDOT has not provided valuation guidance or a reference to guidance, standard industry practice has been applied.

All benefits and costs are estimated in 2010 dollars in the analysis, and annual costs and benefits are computed over a long-run planning horizon of 30 years and summarized through a lifecycle cost analysis.

2.1.4 The Opportunity Cost of Capital

The opportunity cost associated with the delayed consumption of benefits and the alternative uses of the capital for the implementation of the project is measured by the discount rate. All benefits and costs are discounted to reflect the opportunity costs of committing resources to the project. Calculated real discount rates are applied to all future costs and benefits as a representation of how the public sector evaluates investments. A 7 percent real discount rate is used in the analysis, with a sensitivity test at 3 percent.

2.1.5 Model Structure

When conducting a benefit-cost analysis, a baseline scenario is compared to an alternative. For this study, the current railroad condition is considered the baseline and the railroad improvements are the alternative. Data from numerous sources are combined using a variety of relationships and TIGER II guidance to develop benefit and cost estimates.

3. TRAFFIC ESTIMATION

Benefits and costs in the analysis are generated by several key drivers. Current freight volumes transported by rail, as well as the likely new traffic generated with the improved rail, impact shipper cost reductions. Benefits related to roadway users, safety, and the environment are estimated based on vehicle miles traveled (VMT) before and after the improvement.

3.1 Estimating Rail Traffic

Rail traffic data were developed for two specific scenarios: a “no build” scenario and a “build” scenario. The “no build” scenario assumes the NHN railroad condition remains the same as it is today. Currently, NHN handles 4,000 rail cars each year. The “build” scenario assumes that the NHN condition is improved as described in this application and that the railroad would be capable of transporting up to 12,500 rail cars annually.

As part of the “build” scenario, it is assumed that existing shippers will increase the freight they ship on the NHN by two percent per year, until reaching existing capacity which occurs over a 5 year period. In addition, some truck shipments will move to rail because of the improvements. For the analysis, it is assumed that an additional seven percent will be diverted annually from highway to the railroad, once the railroad upgrade is complete.

3.2 Vehicle Miles Traveled

The road user benefits estimated in the Benefit-Cost Analysis are due to reduced truck VMT that result from the transfer of some trucked freight to rail transport. Using the VMT data, as well as other information provided by the TIGER II grant guidelines and other sources, estimation of benefits for the analysis was completed.

4. BENEFITS AND COSTS ASSOCIATED WITH THE NORTHCOAST RAIL UPGRADE

The benefit-cost analysis expresses benefits and costs monetarily in “present value” capturing the flows of benefits and costs over the project horizon. The most common metrics of benefit-cost analysis are the Net Present Value (NPV) and Benefit Cost Ratio (BCR). The NPV is the sum of the present value of future cash flows less the present value of the project’s cost including operations and maintenance expenditures. The BCR is expressed as the ratio of benefits of a project relative to its costs, both expressed in present-value terms. A BCR above 1.0 suggests that benefits exceed costs, in which case the projects create a positive return on investment.

4.1 Benefits

The benefit-cost analysis for the Northcoast Rail improvements measures four primary categories of benefits: freight rail user benefits; environmental benefits; safety benefits; and highway user benefits.

Freight Rail User Benefits

- Shipper Cost Savings – reduced freight shipping costs which result from shifts to less expensive per ton mile modes (e.g., truck to rail) and/or improved service on existing routes; freight inventory costs were also incorporated to better reflect true shipper benefits of the project.

Environmental Benefits

- Congestion Relief Benefits – benefits that result when freight traffic volumes are diverted from roadways to rail, reducing overall traffic congestion;
- Emissions Benefits – environmental benefits when freight is shipped by more energy efficient modes that produce fewer emissions per ton mile (e.g., from truck to rail).

Safety Benefits

- Safety Benefits – savings that result from a reduction in the number of accidents when congestion is reduced on roadways.

Highway Related Benefits

- Pavement Maintenance Cost Reductions – roadway maintenance savings that are incurred when greater freight volumes are moved off highways and onto rail.

4.1.1 Freight Rail User Benefits

Shippers may choose to transport some portion of their freight by rail, rather than truck, due to the improvements envisioned for this project. Rail is a less expensive per ton mile mode than trucking, and this may induce some businesses to alter the manner in which they transport some freight. These reduced freight shipping costs are incorporated in the benefit-cost analysis. In addition to the shipping cost savings that will result from the railroad upgrade, freight inventory costs were also estimated to better reflect the true benefit to freight rail users of the proposed improvements.

4.1.2 Environmental Benefits

The NHN project will improve the overall railroad, which will spur additional business by existing rail customers who will choose to move more freight because of the improved condition of the railroad. Additionally, some businesses may switch from using trucks to ship their freight to rail, due to the upgrades. Truck traffic will be reduced as a result, which will decrease roadway congestion.

Emissions reduction benefits will also be generated by the improved railroad condition. Rail is more energy efficient and produces fewer emissions per ton mile. Because some freight will be moved from truck to rail, overall emissions will be reduced. Emissions measured in the analysis include VOC (HC), CO, CO₂, NO_x, SO₂, and PM.

4.1.3 Safety Benefits

The reduction of accident costs, like other variable costs, is dependent on the reduction of vehicle-miles. With the improved railroad, some vehicles will be removed from the roadways as shippers opt to use rail instead of trucks to transport their freight. The reduction in vehicles on the road is combined with a multiplier, which is a weighted average of fatal, injury, and property damage only (PDO) accidents. This calculation provides an estimate of the accident reduction benefits associated with the upgraded rail project.

4.1.4 Highway Related Benefits

When the railroad is improved and some portion of freight is shifted from truck transport to rail, congestion on the highways and VMT are reduced. The reduction in VMT generates savings in the costs associated with the operation and maintenance of automobiles and trucks. In the analysis, vehicle operating costs include fuel, oil, depreciation, tire wear, and maintenance and repair. The vehicle operating cost savings are part of the overall calculation of benefits attributable to the project improvement.

Because of the reduced VMT, the costs associated with damage to the road surface are also decreased, and these pavement maintenance cost savings are included in the analysis.

4.2 Construction and Operating and Maintenance Costs

The costs of the project consist of initial construction costs, as well as operation and maintenance (O&M) costs. The rail upgrade is expected to cost \$2.3 million. Operating and maintenance costs for the rail are estimated to be \$3.6 million over the 30 year period.

5. BENEFITS AND COSTS ESTIMATION

5.1 Estimation of Benefits and Costs

The following section provides detail on the benefits and costs to railroad and highway users, as well as society generally. For the purpose of estimating the costs and benefits, it is assumed that the rail upgrade will begin in 2011 and be completed by the beginning of 2012. Operating and maintenance costs occur annually, while construction costs are only incurred in the relevant construction period. Benefits increase annually as well.

5.1.1 Freight Rail User Benefits

Modal shifts reduce freight shipper costs by shifting to less expensive per ton-mile freight modes or through improved service on existing routes; for example, truck to rail modes. Diverting freight traffic from truck also alleviates congestion on highways. While rail has lower shipper rates, the needs of shippers and customers of logistics services usually require some balance of connections, speed, reliability, and cost. These tradeoffs between time and costs are reflected in the analysis. Through a combination of sources including US Rail Desktop, industry experts, and other research, it was determined that the average shipper cost savings from diverting a ton-mile of freight from truck to rail is a savings of \$0.03. The difference between the modal diversion and induced volumes were used to calculate the total cost savings. Freight inventory costs were estimated in the analysis to reflect the total estimated travel time of freight shipments. Since freight rail tends to be lower-cost but often longer travel time compared to truck, this impact actually works as a modest negative offsetting impact as the analysis captures the trade-offs between truck and rail modes.

Freight volumes for the existing conditions were estimated using historical freight volumes and applying an annual growth rate consistent with the Congressional Budget Office (CBO) Gross Domestic Product (GDP) economic forecast. For the baseline (no-build) condition, freight volume was capped once carload volume reached 4,000 carloads per year based on railroad speeds, schedules, and available equipment. The build scenario incorporated the same growth but also incorporated potential new customer freight volumes. The railroad has identified specific new freight customers and generated a likelihood in percentage terms of business growth. These percentages were applied to tonnage estimates to determine the potential new customer growth once the project is complete. Total growth in tonnage was capped at 12,500 carloads per year in the build scenario, because the railroad would be unable to accommodate volumes beyond that point. Shipper cost benefits in the analysis are estimated to be \$28.4 million.

5.1.2 Environmental Benefits

Once the railroad improvements are made, it is anticipated that some freight traffic will be diverted from truck to rail. This will remove some trucks from the highways, thus reducing congestion. Congestion benefits of the project total \$6.4 million and reflect a savings an average annual savings of 1.9 million truck VMT.

Freight rail transport is more energy efficient than truck. With the improved rail, and the subsequent diversion of some freight from truck transport to rail, emissions will be reduced. Emission benefits are calculated as the difference between the emissions generated when freight is transported by truck and the emissions generated when it is moved by rail. The Environmental Protection Agency's values of grams per mile of emission were used to estimate the change in emissions from reduced VMT and were monetized using estimates of dollars per ton of emission from FHWA's HERS and the Victoria Transport Policy Institute. Emissions measured include VOC (HC), CO, CO₂, NO_x, SO₂, and PM. The investment in this rail project will result in total emissions benefits of \$1.4 million.

5.1.3 Safety Benefits

Reduced vehicle traffic will also decrease the likelihood and cost of accidents. The National Highway Traffic Safety Administration (NHTSA) provides guidance on the rates per 100 million VMT for accidents and fatalities. These accident rates were applied to the annual VMT estimates to determine the number of accidents by category: injury, fatality, and property damage. Estimates for the cost of each type of accident from US Department of Transportation were then applied to the number of accidents by type to monetize the benefits associated with fewer accidents. In the Benefit-Cost Analysis conducted for this application, cumulative accident reduction benefits are estimated to be \$2 million.

5.1.4 Highway Related Benefits

A pavement maintenance cost reduction is another benefit of reduced vehicular traffic. Based on the Federal Cost Allocation study of 1997, a pavement maintenance cost of \$0.13 per mile (in \$2010) for trucks was used. A reduction in traffic leads directly to a reduction in these maintenance costs. Total pavement maintenance cost savings are estimated to be \$6.8 million due to the rail upgrades.

5.2 Summary of Benefit-Cost Results

The Northcoast Rail improvements will result in total benefits of \$11.4 million, when discounted by 7 percent. The present value of total costs associated with this project is \$3.4 million, and the net present value is \$7.9 million. The BCR is an impressive 3.3 at 7 percent and 5.4 at a 3 percent discount rate.

A summary table of the benefits and costs associated with the rail improvements proposed in this application is provided in Table 2.

Table 2: Summary Table of Benefits and Costs for Northcoast Rail Improvements

7% Discount Rate		3% Discount Rate	
	Millions of 2010\$		Millions of 2010\$
BENEFITS		BENEFITS	
Emissions Benefits	\$1.4	Emissions Benefits	\$1.4
Shipper Cost Savings	\$28.4	Shipper Cost Savings	\$28.4
Freight Inventory Costs	(\$0.2)	Freight Inventory Costs	(\$0.2)
Congestion Relief	\$6.4	Congestion Relief	\$6.4
Accidents	\$2.0	Accidents	\$2.0
Highway Maintenance		Highway Maintenance	
Savings	\$6.8	Savings	\$6.8
TOTAL BENEFITS	\$44.8	TOTAL BENEFITS	\$44.8
PV of Total Benefits	\$11.4	PV of Total Benefits	\$23.9
COSTS		COSTS	
Maintenance Costs	\$3.6	Maintenance Costs	\$3.6
Capital Costs	\$2.3	Capital Costs	\$2.3
TOTAL COSTS	\$5.9	TOTAL COSTS	\$5.9
PV of Total Costs	\$3.4	PV of Total Costs	\$4.4
Net Present Value (NPV)	\$7.9	Net Present Value (NPV)	\$19.4
Benefit-Cost Ratio (BCR)	3.3	Benefit-Cost Ratio (BCR)	5.4

Because transportation investments involve some level of uncertainty, TIGER II guidelines provide the opportunity to conduct sensitivity analyses of key variables to determine how responsive the benefit cost analysis results are to changes in key assumptions. Sensitivity analyses were conducted for three separate variables: freight growth, the potential new customer growth, and Operations and Maintenance costs.

- **Freight growth.** Once the railroad is improved, the benefit-cost analysis above assumes that freight can grow to a maximum of 12,500 carloads annually. For this sensitivity analysis, freight growth after the improvement is restricted to historical freight volumes of 6,500 rail cars per year. Even with the freight growth cap of 6,500 rail cars, the benefit cost ratio is 2.2 with a NPV of \$4.1 million.
- **Potential new customer growth.** Because of the uncertainty related to potential customer growth once the improvements are made, a sensitivity analysis was conducted to measure the impact on the benefit-cost results of more conservative future business growth assumption. The sensitivity analysis reduced the likelihood of new business by 25

percent. Even with the more conservative growth assumption, the project generates a benefit cost ratio of 2.8 with a Net Present Value of \$6.1 million.

- **Operations and Maintenance costs.** A final sensitivity analysis involved increasing the operations and maintenance costs of the railroad by one-third. Although this adjustment reduced the benefit cost ratio to 3.0 and the Net Present Value to \$7.5 million, the project is still economically justifiable on benefit-cost grounds.